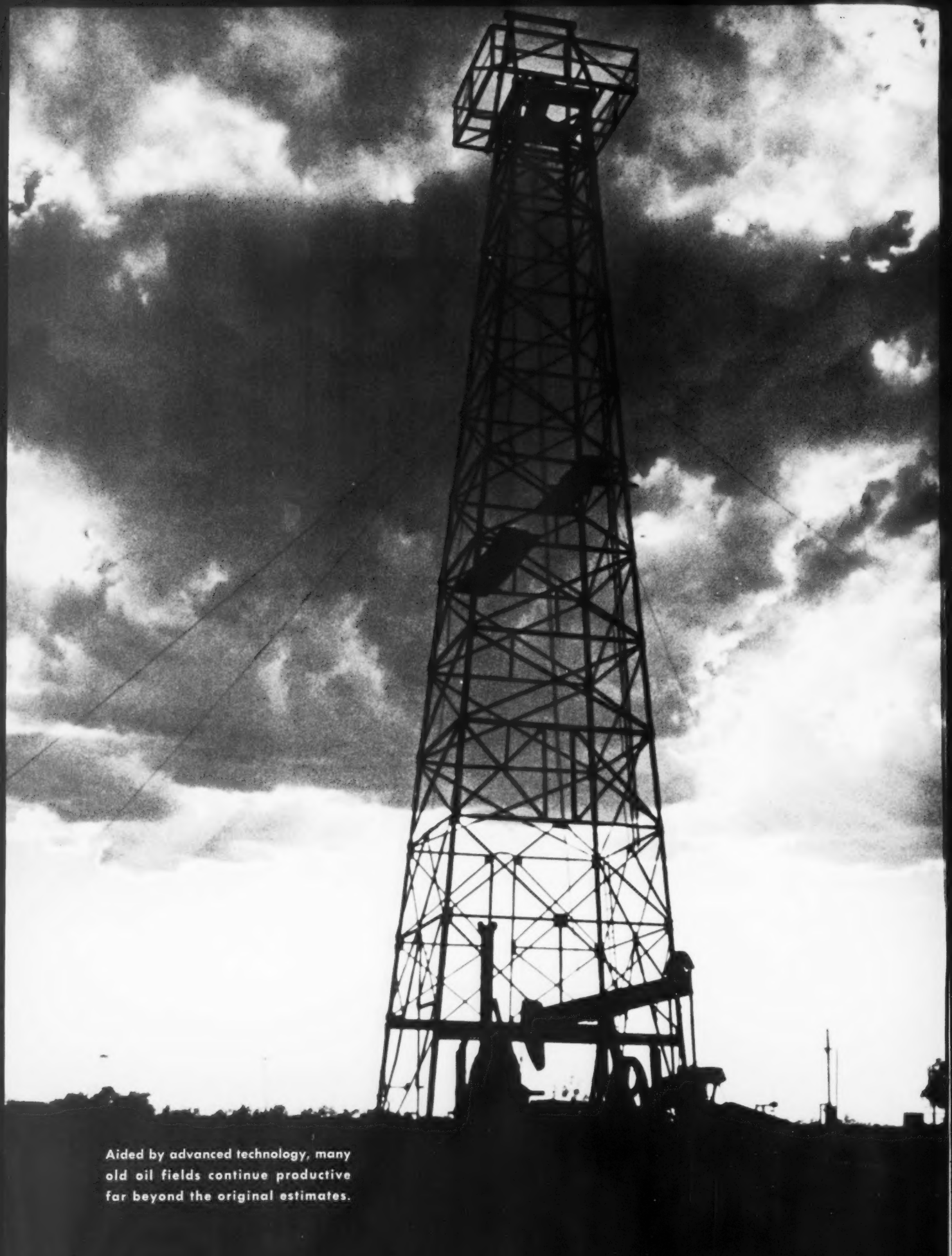
Four Corners Wildcat

E. M. Schiwetz

The Humble Way

NOVEMBER-DECEMBER, 1958



Aided by advanced technology, many old oil fields continue productive far beyond the original estimates.

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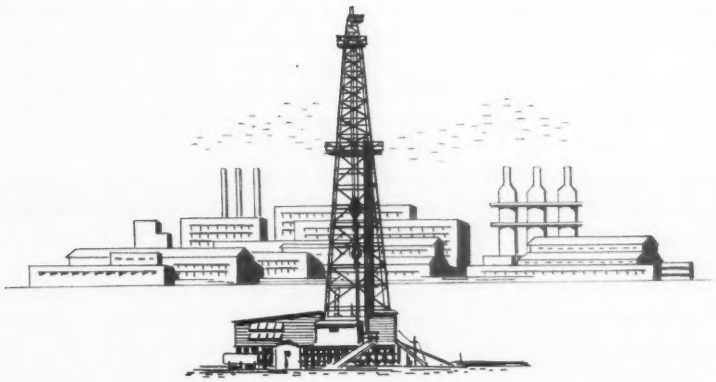


THE DYNAMICS OF DOMESTIC PETROLEUM RESOURCES

By MORGAN J. DAVIS

AS OUR domestic oil industry nears its centennial, some powerful voices are being raised in what sounds suspiciously like the premature preparation of an obituary. This is nothing new. The same cry that we are running out of oil has been raised many times before. It is surprising, however, that the note of alarm should be sounded at this time when domestic production is restricted so far below capacity by lack of markets.

The concern expressed as to a prospective shortage of oil has a hollow ring to domestic producers, particularly those in Texas. In Texas, most wells have been restricted to 12 producing days or less since October 1957, and there seems to be little prospect of returning to 15 days or more for some years except as the result of some unforeseen emergency abroad. In these circumstances, it is not surprising that many domestic producers should wonder if the alarm about future supplies contains elements of propaganda.

Domestic oil is the nation's principal fuel, exceeding coal in importance by a substantial margin. Natural gas is also a major source of energy which may soon displace coal in second position. All of us have a direct and vital interest in an accurate appraisal of our future prospects for these fuels. The American public has a right, therefore, to expect the leaders of the petroleum industry to provide the most accurate and non-partisan analysis that can be made of current and future availability of domestic petroleum supplies.

An evaluation of our future domestic discovery and production of oil and gas is not an easy task. Past prophecies have consistently underestimated the availability of domestic petroleum.

In retrospect, it is clear that the pessimists about domestic petroleum supplies have made their major error in assuming that current conditions would continue indefinitely into the future. Such an assumption is as unwarranted today as it was in the past. History shows that ours is a highly dynamic industry—one with continuously changing conditions. As pointed out recently by Thomas B. Nolan, director of the U.S.G.S., the petroleum industry is one of the best examples of the effectiveness of science and technology, and he comments on "the dangers of projecting current trends into what we can be sure will be the changed world of tomorrow." If we are to make an intelligent appraisal of the future we must deal with the dynamics of domestic petroleum supplies with particular reference to the probable impact of technology both on oil currently available and on that still to be discovered.

The first question of immediate public interest is the current availability of petroleum supplies. This question has been asked of the National Petroleum Council several times since 1947, and resulting studies have consistently shown availability from domestic wells increasing at a faster rate than domestic demand. The Council's latest report showed an ability

A speech before the Annual Meeting of The American Petroleum Institute, Chicago, Illinois, November 12, 1958.

to produce 9,867,000 barrels of crude oil daily as of January 1957. By contrast, the production of crude oil in 1958 will probably average less than 6,800,000, indicating a reserve producibility of not less than 3,000,000 barrels daily. Furthermore, the Council reported that this producibility could be sustained with the drilling of 41,000 to 50,000 wells annually. Since the rate of well completions has been toward the upper end of this range and production has been far below estimated availability, it seems safe to say that current availability is at least 10,000,000 barrels daily compared with estimated production in October 1958 of about 7,000,000.

It is surprising that representatives of some companies have questioned the official estimates of the Council notwithstanding the fact that their own engineers have participated in these studies.

No opportunity to demonstrate producibility

For the most part, criticism of the NPC estimates of capacity seems to result from the fact that since 1948 availability has greatly outstripped production. Thus, there has been no opportunity to demonstrate that the reported producibility could in fact be achieved or, if called upon, could be sustained for any length of time. Skeptics also point to the fact that the reported total producibility constitutes a higher percentage of proved reserves than the relationship existing in 1948.

At first glance, these ideas seem to have a plausible basis. Unfortunately, however, they reveal a lack of understanding of the conditions that govern producibility and of the methods by which it is determined. An article appearing in the November issue of *Fortune Magazine* is one of the latest to misinterpret the available facts.

The producibility reported by the National Petroleum Council is not a guess. It is a figure resulting from competent engineering studies of individual wells and fields by trained specialists. Conditions have changed since 1948. We have today roughly twice as many producing fields in the U. S. containing in the aggregate 40 per cent more reserves and over 100,000 more wells. These new fields and wells have their own individual capabilities, in no way related to those of previously existing fields. They have contributed materially to the present productive capacity.

Perhaps the greatest of all changes since 1948 is the advance in technological developments. The various factors that have increased the rate at which estimated proved reserves can be produced efficiently were set forth in some detail in the 1957 report on productive capacity by the National Petroleum Council. They include: (1) multiple completion of wells, (2) hydraulic fracturing of producing formations, and (3) water floods, pressure maintenance projects and other recognized means of stimulating or maintaining producing rates. The effect of these factors was illustrated in part by the fact that District 3 proved in March 1957 that it could produce at a higher relation to reserves than in 1948 even though prorated wells in Texas were restricted to 18 producing days.

A dramatic example of the type of development that has affected availability is a field in West Texas which is operating with water flood and exempt from shutdown days. North Ward-Estes produced an average of nearly 28,000 barrels daily in 1957—equivalent to an annual rate of production of 14.4 per cent of its estimated reserves of 71,000,000 barrels at the end of the year. By contrast, in 1948, its production of 10,600 barrels daily prior to water flood was equivalent to seven per cent of the reserves estimated at that time, or less than one-half of the demonstrated rate of production in 1958.

A study of individual fields operating efficiently with modern producing practices supports the conclusion already stated that crude oil productive capacity of at least 10,000,000 barrels daily can be counted upon for some years. Since this is more than 40 per cent above the recent rate of production, it is reasonable to believe that the domestic industry can keep pace with the growth of domestic demand for the foreseeable future unless exploration and drilling are curtailed drastically. Continuation of present percentage depletion is a basic need for this result.

These conclusions are particularly significant in the light of the prospects that domestic petroleum demand may increase in the future at an average rate of only three per cent annually, about the same as the long-term rate of growth in domestic requirements for all forms of energy. While petroleum demand has increased at an average rate of five per cent per year over a long period, that rate was possible only while oil was increasing its participation in total energy requirements. This rate of increase cannot continue if coal holds the markets it now has in which it has a price advantage and if gas continues to be an increasingly effective competitor for residential and industrial heating.

The outlook for future discoveries

The second important question about our industry is the adequacy of future domestic supplies. This subject is one that the public will always find difficult to understand because the figures on proved reserves commonly heard leave the impression that our known domestic petroleum resources will be exhausted within a relatively short period of years. This is particularly disturbing to people outside of the industry and is

contrasted with the common belief that coal reserves are sufficient to last a thousand years.

References to coal reserves, however, are usually based not on supplies to be produced by present mines but on estimated "commercial" reserves in place. By contrast, the petroleum industry goes to the other extreme in speaking of its estimated known reserves. Official estimates of the American Petroleum Institute, ably prepared by the Committee on Petroleum Reserves, are restricted to "proved" reserves. These are reserves recoverable at present prices and with presently known technology through wells and facilities in operation although, technically, the estimates include a small increment of undrilled proved reserves. Furthermore, ground rules do not allow the estimation of the effect on a field of secondary recovery and pressure maintenance by fluid injection until the facilities are installed and results demonstrated. As a result, estimated reserves probably average only about one-third or less of the oil in place in fields already discovered.

Actual production will exceed estimate

It is clear, therefore, that our official reports on reserves provide the public with a bare minimum estimate of oil economically recoverable through existing facilities. Those of us who have worked on reserves estimates know from experience that the actual production from known fields will exceed the presently reported estimates by a substantial margin.

The policy of preparing reserves estimates on the present basis was initiated 22 years ago at a time when the nation's chief concern was to keep books on its inventories of recoverable petroleum rather than to estimate *rates* at which oil could be supplied. The Reserves Committee has done a good job, but there is now a question in the minds of some industry people as to whether this type of estimate, by itself, best serves the public interest since, unfortunately, there seems to be a growing tendency both inside and outside industry to use it as a basis for deciding whether domestic supplies are adequate to meet future needs. This use, of course, has neither been encouraged nor condoned by the Committee on Petroleum Reserves.

If the oil industry were to adopt the methods commonly applied in estimating coal reserves, it too could speak of vast potential resources that make our known reserves look insignificant. Many of you are familiar with a recent book by Bruce C. Netschert, a member of the staff of Resources for the Future, which stated that there may be 500 billion barrels of crude oil potentially available for future recovery in the United States. This theoretical concept of a "resource base" to which "the industry can apply its ingenuity and science" serves at least to emphasize the inadequacy of reserves estimates based on our traditional rules when used for the purpose of evaluating future supplies. Beyond Netschert's estimate, we could also add some 500 billion barrels of shale oil and arrive at potential liquid fuel supplies from domestic sources sufficient for hundreds of years. Such estimates, however, are not within the purview of this paper.

History warns us not to place too much confidence in our ability to predict the ultimate amount of oil production to be realized in the United States. Nevertheless, such estimates continue to be made, particularly in recent years. Some of these represent no more than a glance into a crystal ball. Others represent projections or calculations based on an extrapolation from the past, and a few constitute serious studies by geologists and other scientists.

Some years ago, Wallace Pratt, one of the nation's most distinguished geologists, estimated that 100 billion barrels of oil would ultimately be produced in the United States. At that time, his estimate was considered highly optimistic by most of his colleagues, but now his figures are regarded as entirely too low even by pessimists.

Last spring, M. King Hubbert, another outstanding petroleum scientist, made a projection of future oil production in Texas on two bases. Both methods gave an answer of about 60 billion barrels of total recoverable Texas oil with a peak of about 3,200,000 barrels daily in 1962-1965, a rate which had already been exceeded in March 1957. Apparently overlooked in this prediction was the already developed productive capacity in Texas, which has continued to grow to a level now estimated to exceed production by two and one-quarter million barrels daily. If these important considerations had been taken into account, Dr. Hubbert might have concluded that Texas production can continue to rise for 10 to 20 years, notwithstanding his very conservative estimate of ultimate Texas production.

The United States Geological Survey concluded in 1956 that a total of 300 billion barrels as the ultimate reserves of the United States and of the adjoining continental shelves might be a reasonable figure considering significant improvements in recoverability that are now being accomplished or promised in the future.

The prognostications are confusing

Unfortunately, all these widely varying estimates or guesses, however well-meaning they may be, leave confusion and even genuine concern in the minds of those unable to evaluate them. Probably in no other field have so many intelligent prophets been confounded. Beginning with the early days of the petroleum industry, forecasts of shortage by other-

"... the increasing number of small fields has been in a

wise knowledgeable people have come forth at frequent intervals only to fade away before the surprising progress of the industry.

The doubtful value of using estimates of ultimate production in planning for the future is shown by the 1956 estimate of the Chase Manhattan Bank which plotted future crude oil production in the United States on the assumption of an ultimate production of 165 billion barrels. The next year, this same organization had accepted as plausible a *minimum* ultimate recovery of 250 billion barrels. Within one year, the estimate was raised by more than 50 per cent.

Where policy decisions in the public interest are concerned, we would seem to be far better advised to take a critical look at what we can see ahead within a reasonable period of ten to twenty years. Beyond that, there will no doubt be many variables that are unpredictable now, such as other uses of petroleum and development of other forms of energy. One cannot refrain from speculating as to what volumes of whale oil forward-planning New England whalers in the year before the Drake well may have forecasted as the probable requirements for 1958!

The American Petroleum Institute and the American Gas Association report estimated reserves at the beginning of 1958 of more than 30 billion barrels of crude oil, nearly six billion barrels of natural gas liquids, and almost 247 trillion cubic feet of natural gas. The crude oil figures are approximately twice what they were twenty years ago, and close to the peak figure reported at the end of 1956. Since estimated proved reserves have failed to increase much in recent years, some people have concluded that the industry can no longer find enough new oil to keep pace with growing domestic demands. This is not believed to be a correct conclusion. In 1958 production from domestic wells will be only 10 per cent higher than in 1951, but the number of wells and the capacity to produce have increased far more rapidly.

Relation of reserves to current production

Crude oil production in 1957 was slightly more than two and a half billion barrels with estimated reserves at year end about 12 times production. Historically, however, the current relation of reserves to production is not a low one but, instead, is about the average the industry has carried during the past 20 years. In 1937, the estimated proved reserves of 13 billion barrels at the beginning of the year were only 10 times production that year; in 1948, they were less than 11 times production. In 1958, therefore, we are better off in terms of the relation of reserves to production than we were either 10 years ago, when the industry was worried about a shortage of immediate supplies, or 20 years ago when the industry was worried about reserves being discovered too rapidly.

There is another way of looking at the relation of production to reserves that should help to dispel fears that the United States is running out of oil. At the beginning of 1938, the United States had estimated proved reserves of 15.5 billion barrels. In the next 10 years, crude oil production exceeded 15 billion barrels. Yet, reserves were not exhausted but instead increased to 21.5 billion barrels at the beginning of 1948. In the 10-year period ending with 1957, crude oil production exceeded 22 billion barrels, or slightly more than the known reserves at the beginning. Once again, we find the paradox of producing all we said we had and ending up with more than ever before!

A look at the next decade

Proved crude reserves at the beginning of this year exceeded 30 billion barrels. Judging by past experience, it seems reasonable that the industry could, within the next 10 years, produce 30 billion barrels, or approximately the equivalent of its present proved reserves. In this case, demand would increase at a rate a little more than 3 per cent annually, or a total of 40 per cent above the 1958 level. We would then end the period with a production of about 3½ billion barrels for the year 1967. If we assume that proved reserves equivalent to nine or 10 times annual production in 1967 will support the required producibility at that time, then during the next decade we must add about 31 to 35 billion barrels of crude oil through discoveries, extensions, and revisions or approximately the same amount as was added during the past ten years.

This estimate of new crude oil necessary for the next decade is considerably less than some recent forecasts which assume a 5 per cent annual rate of increase in demand and that discoveries must be one and a half times production. The estimate of the Chase Manhattan Bank that 57 billion barrels of additional domestic crude oil would be necessary, if domestic production is to continue to supply 90 per cent of the nation's oil needs, will probably prove to be incorrect for two reasons. First, demand is more likely to increase at a rate of three per cent rather than five per cent, for reasons already stated; and second, improvements in reservoir management will permit reserves to be produced more rapidly. These considerations require a rate of additions to oil reserves only slightly higher than that of the past 10 years.

The crucial issue, then, with respect to future

domestic petroleum supply is this: Can the domestic industry realize through discoveries, extensions, and revisions some 31 to 35 billion barrels of new crude oil in the period 1958-1967?

As just mentioned, the upper limit of this range exceeds the new oil added during the past 10 years only slightly. Since drilling is currently at about the average level for 1948-1957, it follows that the required goal can be reached with a level of activity that will not exceed the 1956 peak and, therefore, one that is easily attainable. The only circumstances that could alter this conclusion would be a continued decline in drilling or a sharp drop in new reserves developed per well.

Under the rules used by the Reserves Committee, the bulk of new oil credited in the next 10 years will continue to come from extensions and revisions, with new fields given relatively minor credit in the years immediately following discovery. In view of the large number of fields found in recent years, and revisions that will result from development and application of improved technology to these and older fields, prospects are quite good that estimates of recovery from known fields will be raised within 10 years by 20 to 25 billion barrels. During this period, it is certain that we will also see some important applications of new techniques, such as enriched gas drive or similar reservoir treatment, which may substantially raise estimates of the percentage of oil in place that can be recovered economically. It is still too early to estimate quantitative effects but if those methods work only half as well in practice as in the laboratory, the industry will see surprising increases in recovery. Finally, more orthodox fluid injection methods will be applied to an increasing number of old fields. Paul Torrey has estimated that at least 11 billion barrels of oil may be recovered from presently known fields by secondary projects still to be initiated. During the next 10 years, several billion barrels from this source should be added to the estimates of recoverable crude oil. The sum of all these possibilities for improved recoveries from existing fields might even exceed production expected during the next decade.

The probable results of exploration

Our analysis leads finally to the probable results of exploration activities in locating new sources of supply. Here we must take into account the untested prospects already located as a result of past exploration and other possibilities on some 350 million undeveloped acres currently held under oil and gas leases, as well as the potential of acreage remaining to be leased in future years.

A quick calculation provides the basis for optimism rather than pessimism about future discoveries. On the conservative assumption that only two per cent of the 350 million acres of undeveloped leases will produce oil and that the average ultimate recovery per acre will be 5,000 barrels, the recoverable reserves from new fields on this acreage may ultimately exceed 35 billion barrels. There will also be much additional leasing of land and a number of discoveries on new acreage before 1968.

Large fields still being found

One hears quite often the view expressed that the large fields have already been found and that all we can find today are small fields with thin sands. Those familiar with exploration are aware, of course, that this supposition is not true. The fact is that the industry is continuing to find fields with substantial reserves at about the same rate as in former years. This statement is based on Humble studies of discovery frequency of fields with reserves of 10 million barrels or more. What has confused the picture is that concurrently with the finding of large fields, there has been an enormous increase in the number of small fields found in recent years.

The significance of this situation from the standpoint of future oil discoveries is that the increasing number of small fields has been *in addition to,* rather than *in lieu of,* large fields. These small fields thus represent an added source of supply, a source made available largely through improved technology in both exploration and well completion.

The continuing discovery of large fields is not confined to new provinces. Both old and new areas contribute. An example of a major field in an old producing area is the Neches field in East Central Texas, discovered in 1953 after many dry holes had been drilled around it. Another example is the Headlee-Dora Roberts area in West Texas, discovered in 1953-1955. New provinces offer still more intriguing prospects. Offshore Louisiana includes several fields that can already be rated as major, and a number of others that will probably turn out to be quite large. In Utah there is a new major field, or group of fields, although the search there has barely begun. Unquestionably, Louisiana and the Four Corners Area will be credited with substantial increases in reserves in 1958 and in years thereafter. In California, there are known producing structures that still remain to be developed and produced from large offshore extensions. In addition, a number of large untested offshore structures have attracted high bonus bids on the small portions so far offered for lease. In our newest state, Alaska, the commercial search for oil is just beginning, with the prospects rated promising by many companies.

An analysis of the outlook for domestic oil discoveries leads to the conclusion that they will keep pace with national needs during the period under discussion. Even a cursory survey with little allowance for improvements in recovery techniques makes it possible to forecast within the next 20 years *minimum* additional supplies of about 70 billion barrels of crude oil alone from known fields and acreage already under lease. Since this is in addition to the present proved reserves of 36 billion barrels of petroleum liquids, the public can be reasonably sure that the United States will not soon experience a shortage of petroleum. If our search for oil slows down, as at present, it is not due to a lack of new prospects but because there is a lessened incentive to continue an aggressive search in view of an already burdensome surplus producing capacity and an uncertain outlook as to future markets for domestic production. Our national policies for the foreseeable future of 10 to 20 years at least, and probably for longer, can, if we choose, be formulated on the basis that domestic sources can continue to supply the same proportions of total demand that they have in recent years.

Adequate supplies at reasonable prices

The final question that requires consideration is the ability of the domestic petroleum industry to meet increasing requirements at reasonable prices. A survey of past economic data, which need not be detailed here, shows that petroleum has been reasonably priced to date despite deeper drilling, rising costs of materials and labor, and other factors that have alarmed us about future costs.

Two principal errors account for much of the misconception about the rate of increase in the cost of domestic crude oil in recent years. The first is the tendency to overlook the effect of improved technology in offsetting inflation. The other error lies in the implicit assumption that all exploration, drilling, and producing expenditures are related to crude oil only. Needless to say, industry finding and producing costs must be related not only to crude oil but also to natural gas liquids and natural gas notwithstanding the difficulties involved in the allocation of such costs.

Several other considerations concerning costs deserve brief mention. First, all unit costs are adversely affected by severe restriction of production. At present because of limited markets, the domestic industry is producing only about 70 per cent of maximum efficient capacity, and probably not more than 55 per cent in Texas. Second, we have not been developing reserves as economically as we should. Most of us know that reserves can be developed and produced efficiently in many fields with far fewer wells. With the cooperation of state regulatory agencies, the industry should make rapid progress toward more efficient spacing of wells. Finally, for reasons previously discussed, the application of improved recovery methods on a wider scale must raise ultimate yields beyond current reserve estimates with obviously favorable effects on costs.

A summary of main points

In conclusion, I should like to summarize my main points:

First, the United States is not poor in petroleum reserves or resources. Reserves of oil and gas are near the all-time high. We have an adequate working inventory in terms of current requirements.

Second, the current reserve availability of crude oil in the United States is large—more than 3,000,000 barrels per day above present production and is sustainable for many years if the industry continues an aggressive program of exploration and development.

Third, we have a sound basis for reasonable optimism that discoveries and reserves of petroleum can keep pace with increasing domestic requirements for a long period. In the next 20 years, with little allowance for increased recovery due to improved techniques, we can add a minimum of 70 billion barrels of supply, above the 30 billion barrels of crude oil now estimated.

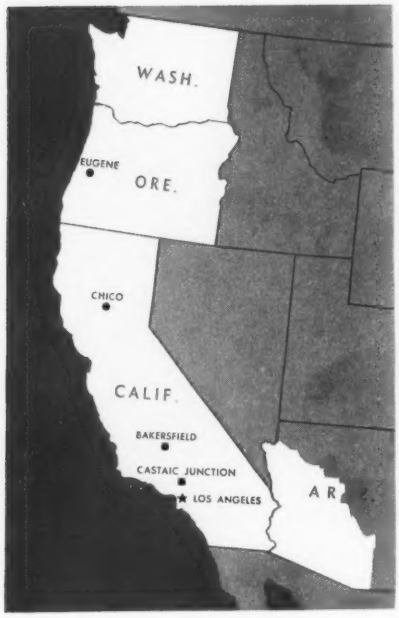
Fourth, the reasonable cost of domestic oil and gas, compared with other sources of energy can be maintained so long as the industry continues its technological progress and is assisted by regulatory agencies to be as efficient as it knows how to be.

In presenting this analysis, I wish to emphasize the necessity of considering the dynamic nature of the petroleum industry in an appraisal of the future of domestic supplies of oil and gas. In my judgment, the past is only a prologue to what still remains to be accomplished.

The prospects for the domestic petroleum industry could be changed drastically, however, by unwise actions by state regulatory agencies, the Federal government, or the industry itself, on such matters as conservation, percentage depletion, and import policy. It has taken a long time to build the present vigor of the domestic petroleum industry, and such vigor, once impaired, cannot quickly be restored.

Finally, I wish to repeat that it is not in the best interest of our nation or of this industry to underrate either its past achievements or its capacity for future progress. On the contrary, I consider it our duty as citizens and as suppliers of petroleum to present to the American public the clearest picture possible of present and future domestic oil supplies. On that score, it is difficult to see how there could be important differences among us once we have examined the same basic facts. The record speaks far more eloquently than I can on the remarkable achievements of our industry. It can only hint, however, at the important technological developments on the threshold of realization. If we can only capitalize on the opportunities ahead, the dynamic tradition of our industry will continue to prevail and our domestic petroleum supplies will contribute to our economic welfare and national security for many years to come.

Humble On The West Coast



IT HAS now been a little more than 10 years since Humble first opened an office in Los Angeles and joined the continuing search for oil in California. During that decade the Company's exploration teams have ranged from the balmy orange groves of Southern California across the Colorado River into southwestern Arizona, and north to the flanks of snow capped mountains in Oregon and Washington. Following up on geologic and geophysical indications, the churning bits of numerous wildcat wells have probed the Golden State from sites in dry river beds, atop rugged mountains, in verdant valleys, in thickly populated suburban areas, along the ocean shores, and out into the waters of the Pacific itself.

Many of these costly test wells have been dry holes, of course, but an encouraging number of them have discovered new oil and gas reserves. Today, Humble is operating 133 producing oil and gas wells in California, with net production of 7,255 barrels a day. In addition, the Company owns joint interest in a number of producing properties operated by other companies.

To help carry on these expanding activities on the West Coast, Humble has set up four operating districts under the area headquarters in Los Angeles. Two are production districts with offices at Bakersfield and Castaic; exploration district offices are located at Chico, California, and Eugene, Oregon. Altogether, the Company has 170 employees on the West Coast.

Let's take a look at some of the current activities in that area of operations.

Wildcat In A Metropolis

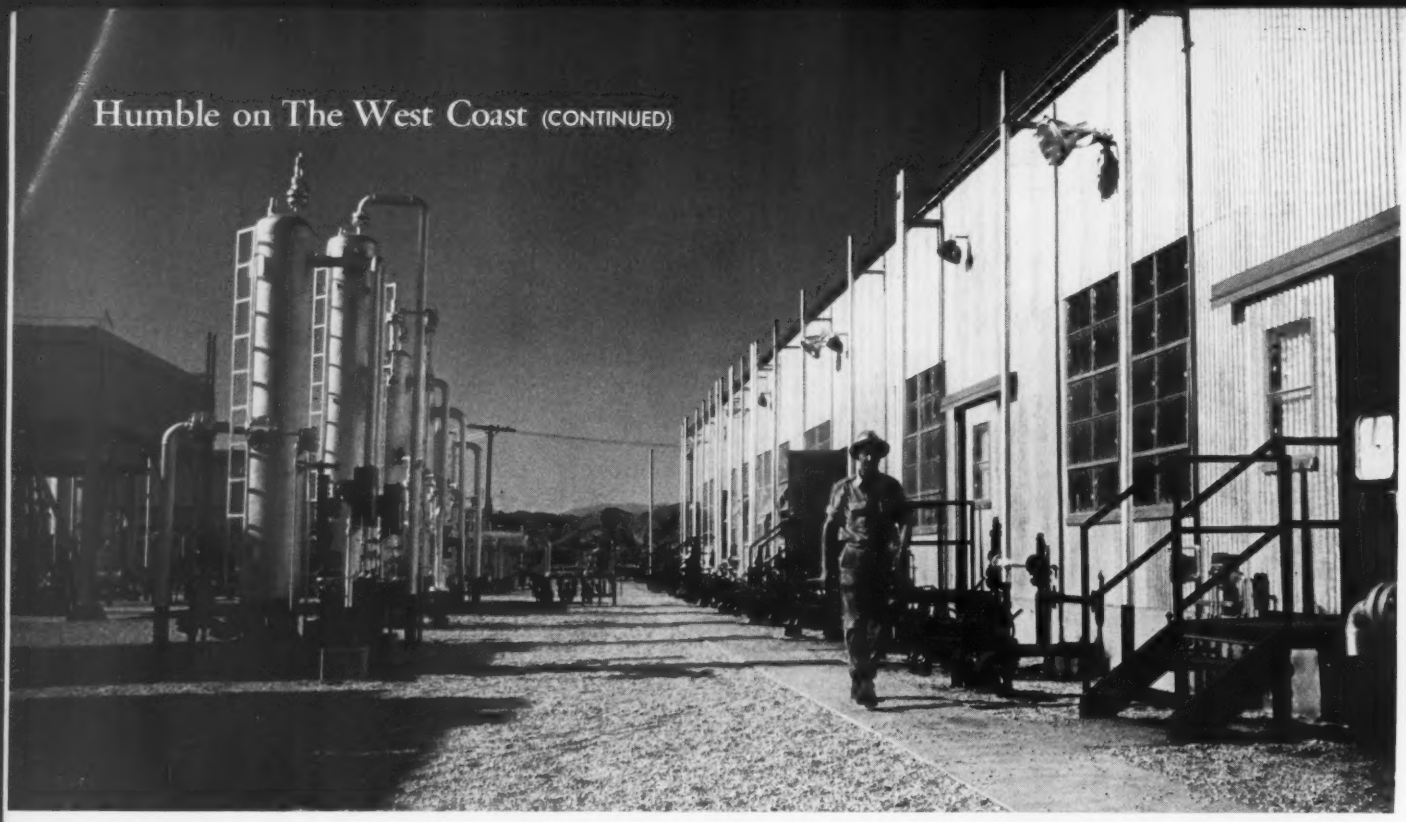
JUST outside the Los Angeles city limits and a stone's throw from the teeming San Gabriel Freeway, Humble this month spudded in a wildcat well to test a 1,300-acre unitized block in the heart of a populated suburban area. Although the drilling site is not in a city, the lease block lies partly in five separate municipalities and Los Angeles County. This block of leases represents a monumental job of unitization, for it involves more than 4,000 individual property owners. The average lease in the block is less than one-third of an acre.

Because of its proximity to residences, the well is being drilled in a manner to keep it as inconspicuous as possible. The entire drilling site covers only a little more than one acre, and is completely enclosed by an attractive wood fence, eight feet high and painted a pleasant green. All equipment, materials, and supplies are kept out of sight inside this fence.

The derrick, of course, is visible above the fence, but it is covered with blankets of green sound-proofing material so that it is not objectionable from either a noise or appearance standpoint.

Preparing drilling site inside the fenced enclosure, contractor's crew sets forms for the deep concrete cellar where rig will be erected. Cars in background are on San Gabriel Freeway.

Before erecting the derrick, Humble prepared a permanent concrete cellar 13 feet deep and long enough to permit drilling three wells 10 feet apart. If the wells prove productive, the Christmas trees will be installed in this cellar and will not extend above the surface. Also, in the event the test wells become producers, the wood fence surrounding the site will be replaced by a permanent brick wall which will encompass 4.5 acres and enclose the low lease tanks as well as the completed wells.



Compressor station at Castaic Junction Field sits high upon a hill and feeds three streams of gas for injection at different pressures into three producing zones. This program, which may double ultimate recovery of oil from the field, is speeded up by use of borrowed gas.

Repressuring At Castaic Junction

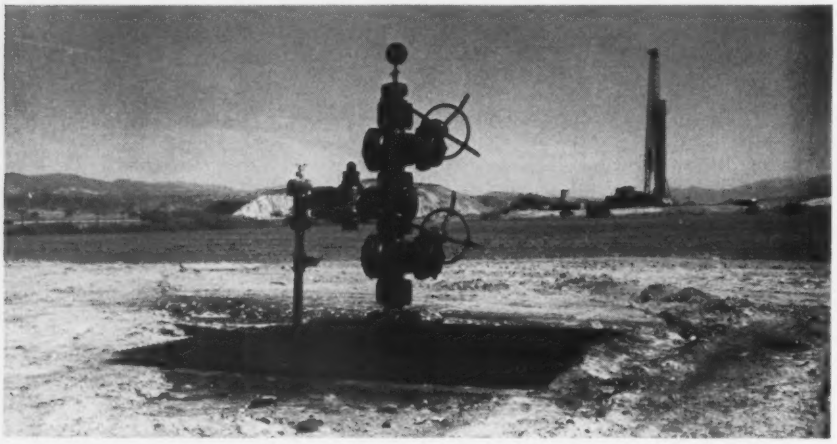
IN THE Castaic Junction Field, which accounts for about half of Humble's total net daily oil production in California, the Company is now using borrowed gas to help speed up a repressuring and recycling program that may double the ultimate recovery of oil from the field.

Under an unusual swapping arrangement with Pacific Lighting Gas Supply Company, Humble borrows five million cubic feet of gas daily from PLGS during the summer months and pays it back when needed in cold weather at rates of up to 25 million cubic feet a day for a maximum of 10 days at a time. The arrangement is mutually beneficial: Humble gets the extra supply of gas it needs to expedite the Castaic Junction repressuring program, and PLGS Company gets a readily available source of extra gas for winter-time emergency needs.

The borrowed gas is but part of the 20 million cubic feet a day now being compressed in Humble's recently enlarged Castaic Junction compressor station and re-injected into the three productive reservoirs of the field. The remainder comes from the field itself in the form of casinghead gas from the two oil producing zones and stripped gas from the gas condensate producing zone.

As the project now operates, both oil zones and the gas condensate zone are being repressured with injected gas. When the gas condensate zone is pumped up to near original pressure, gas will be cycled to increase recovery of liquids and also to conserve a reserve of dry gas that can be injected later into the oil zones to increase oil recovery.

The Castaic Junction Field was discovered by Humble in 1950 and the Company is now drilling well No. 62, a stepout well on the east side. The field is producing about 4,000 barrels of oil a day from 56 producing wells.



Development drilling continues at Castaic Junction nearly nine years after the field was discovered. Rig in distance is drilling well No. 62; the completed well in foreground is No. 61.

Seismic shot erupts from a field in northern California's rich Sacramento Valley.

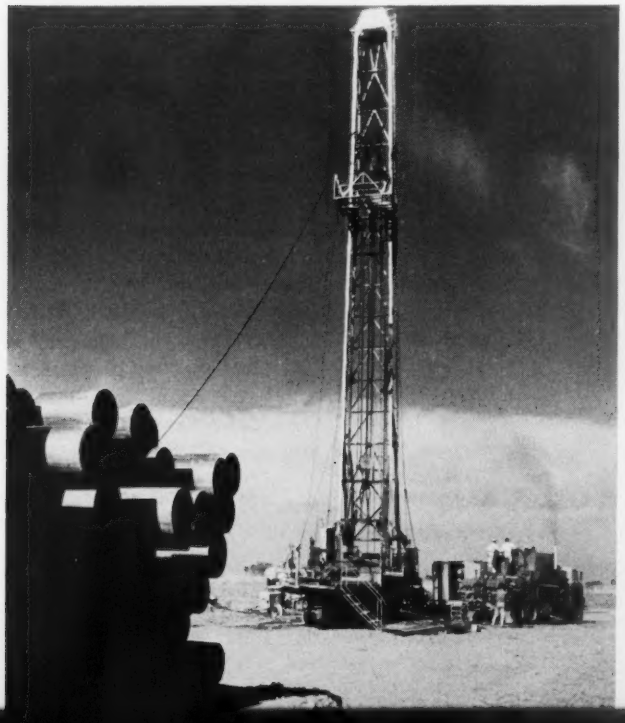
The Search Goes On

THE golden valley of the Sacramento River, in northern California, and the rainswept forests of southwestern Washington are two of the many colorful areas where Humble exploration efforts continue unabated.

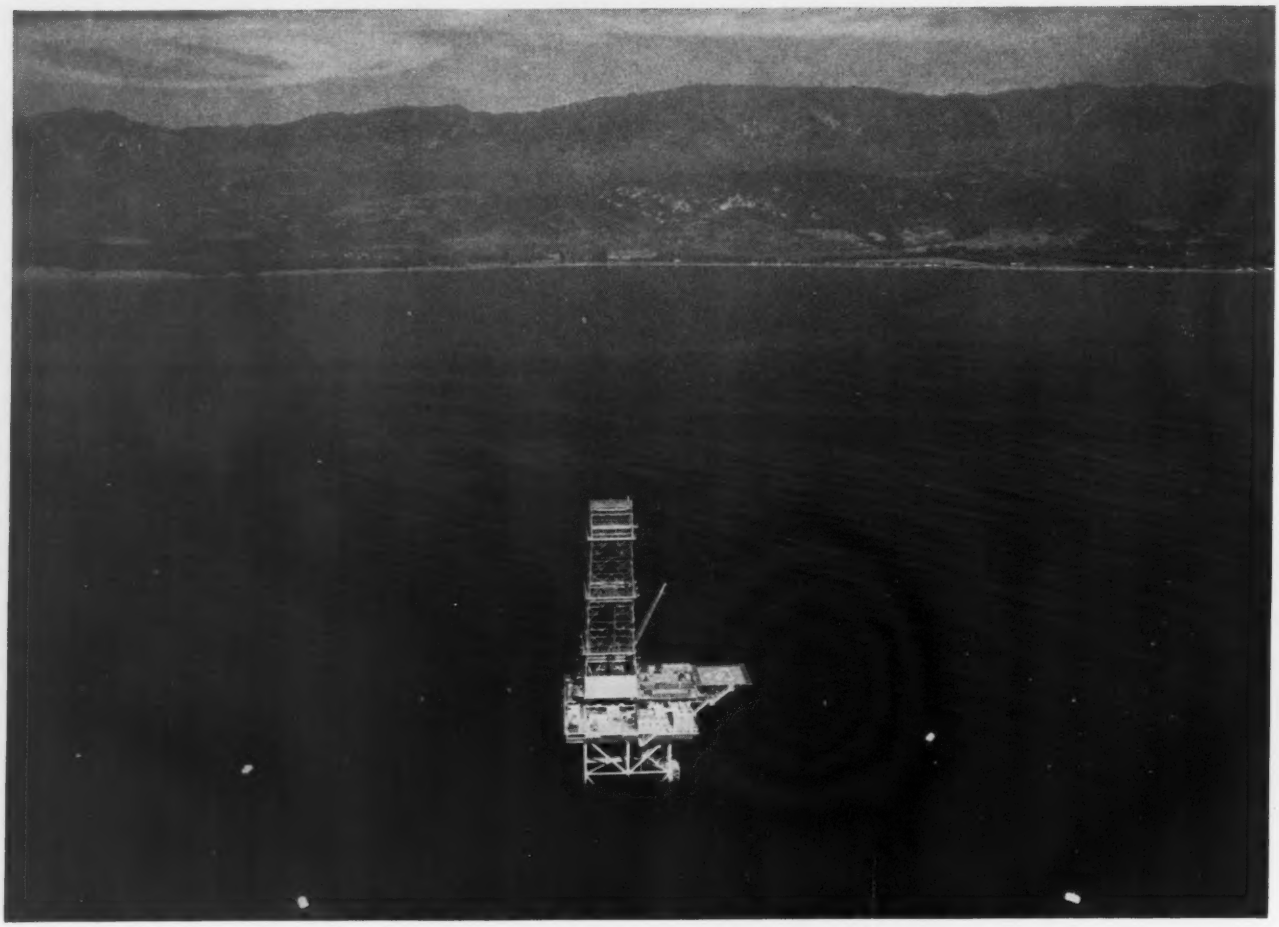
A visitor to these regions in mid-November could have observed an interesting variety of oil-hunting activities. Within a 30-mile radius of the Company's district office at Chico, for example, he could have seen (1) a 7,500-foot Humble wildcat well "making hole" toward a test of the Kirkwood prospect; (2) a seismic exploration party shooting its way across a field of rice stubble; (3) a core test hole being completed as a producing well after the bit had found commercial gas sands. Also within this same area he could have found five Humble-operated gas fields, tangible results of earlier exploratory efforts.

Traveling 450 miles north of Chico, the visitor could have observed another phase of the Company's oil hunting activities being carried on near Longview, Washington. There, among the tall trees and steep slopes of the coastal mountains, a Humble gravity meter party continues its search for additional information that may some day lead to the discovery of more new reserves of oil and gas.

Core test hole in Chico District hit commercial gas sands and is completed as a producer. Several wells have been made in this manner.



In green forest of southwestern Washington, members of Humble gravity meter party gather information to help the search for oil.



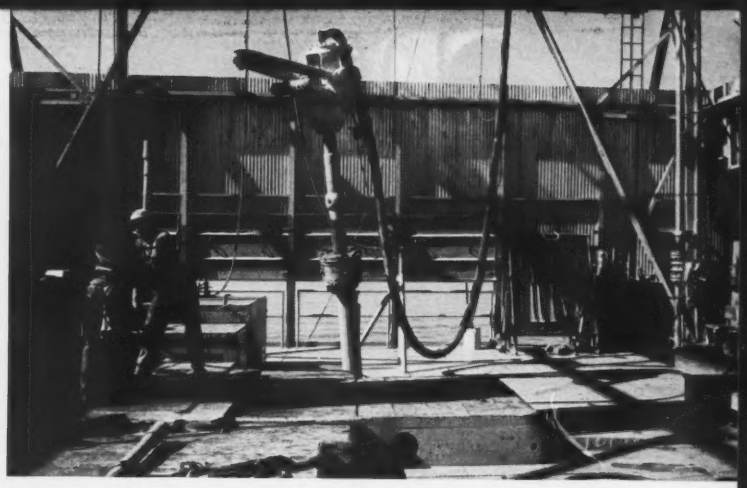
Helicopter view of the offshore platform in the Pacific shows California's coastal mountains in the background. Venture is a joint project of Standard Oil Company of California and Humble, with Standard's Western Operations, Inc., serving as operator.

Oil In The Pacific

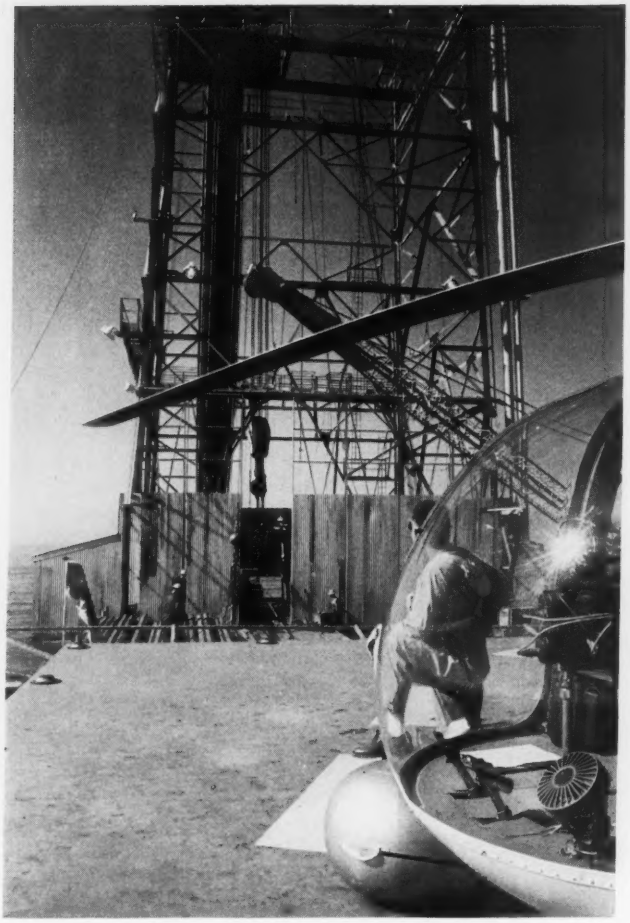
A JOINT venture of Standard Oil Company of California and Humble Oil & Refining Company has resulted in a new offshore oil discovery in the waters of the Pacific off the coast of California. The discovery may prove to be one of major importance.

Operated by Standard's affiliate, Western Operations, Inc., the discovery well was drilled from a permanent-type platform located in 100 feet of water 2.2 miles offshore from Summerland and nine miles southeast of Santa Barbara. This location is on a 5,500-acre lease awarded jointly to Standard and Humble by the State of California early last year for a bonus bid of $7,250,000. Acting as equal partners, the two companies also spent about $1 million core testing the lease block and

Drilling platform base is lowered into place in 100 feet of water offshore from Summerland with help of a barge-mounted crane.



Drilling crews have plenty of room to work on this derrick floor; the big platform was designed to drill two wells simultaneously.



Impressive size of specially designed derrick is apparent in this view across pipe rack from the heliport. Derrick legs are 45 feet apart.

Blowout preventer is on cellar deck, as will be Christmas trees of completed wells. A total of 25 wells can be drilled from the platform.

more than $4 million for the special drilling platform before spudding in the first wildcat test last September.

The massive, triple-decked platform—first of its kind on the Pacific Coast—was designed by Standard's engineers and fabricated at San Diego. From there the basic structure, floating on its four huge caisson legs, was towed 200 miles through the ocean to the location near Summerland. The caissons were then jetted into the ocean floor and were filled with 6,000 tons of sand and concrete.

To oilmen familiar with offshore operations along the Gulf Coast, the big platform in the Pacific seems unusual in many of its features. Its oversize derrick, for example, rises 162 feet above the main deck but does not have an apex. The derrick legs are 45 feet apart at the base and 30 feet at the top. Inside this odd-looking truncated derrick 25 separate wells can be drilled, and, if necessary, they can be drilled two at a time. There is ample room for two crown blocks, two drawworks, and two rotary tables.

Since the platform is designed to operate without a tender, complete facilities have been built into the structure for handling mud, cement, drill pipe, and all the other drilling necessities. There are also emergency sleeping quarters for crew members, although normally the crews are transported by helicopter to and from shore each day; in foggy weather by boat.

In order to minimize noise, electric motors supply power for the drawworks, mud pumps, hoisting crane, and other equipment. The electricity comes from shore by means of a 16,500-volt cable laid along the ocean floor. In the event of a power failure, two emergency generators on the platform start up automatically and provide enough current to operate all equipment.

The long-range plan is to drill the remaining holes directionally to the bottom-hole locations. When drilling is completed, the derrick and most other equipment will be removed from the platform, leaving only the completed wellheads with automatic production devices. Future plans call for the oil produced from the wells to flow by submarine pipelines to onshore facilities for transportation to refineries.

Meantime, Standard and Humble are testing another offshore lease at Gaviota, about 30 miles up the coast from the Summerland platform. The 3,840-acre Gaviota lease was awarded jointly to the two companies for a bonus bid of $12.4 million.

It will take a tremendous amount of oil to pay back the investment in these two offshore ventures. Although the first test has brought encouraging results, only time and the investment of a lot more money in additional wells and operating costs will tell whether the gamble was a good one.

Spores,

Enlarged photographs of spore and pollen samples are examined by Dr. Stuart Levinson, left, and Dr. Russell Jeffords at Humble's Houston Research Center. Plant microfossils help determine age and zoning of deeply-buried sediments.

Microscopic particles left by ancient plants aid scientists in search for petroleum

IT WILL come as little comfort to eight million American hay-fever victims, but the same thing that makes them sneeze is helping the petroleum industry find oil.

That would be pollen, the wonder dust of nature that propagates plant life on one hand, and deals watery-eyed misery to those allergic on the other. Lately, petroleum geologists, who leave no stone unturned, have enlisted pollen—and its elder cousin, the spore—as promising allies in the search for oil.

Pollen grains are the male reproductive cells of flowering plants such as roses and cotton; spores are the reproductive bodies of non-flowering plants such as the ferns and mosses. To Humble exploration scientists, spores and pollen represent much more: a new and better tool with which to determine geologic time.

Millions of years ago, the earth was ruled by great flesh-eating dinosaurs, some of them measuring 50 feet from tiny head to tail tip and weighing many tons. Under paw and claw, these strange lumbering beasts trampled plants, some of them surprisingly similar to those we see today. In prehistoric Texas, for example, there flourished many types of modern plants. The forests stood with pines, oaks, birches, beeches, and maples. Shrubs such as laurel, ivy, hazelnut, and holly made up the underbrush.

As the dinosaurs died out, the bones

, Pollen, and Oil

of a few (but only a few) fossilized in bogs and swamps. The plants, ironically, left behind a much more exhaustive record of their existence. Ancient winds tossed their spores and pollen in every direction. Many swelled under the blistering sun and exploded. But rapidly accumulating sediments snared untold numbers of them. Today, Humble scientists collect these infinitesimal plant fossils from oil-well cuttings and cores. Studying them under powerful microscopes, they are uncovering secrets which the earth's crust would divulge in no other way.

PALYNOLOGY, the study of spores and pollen, is a branch of a paleontology, the broad science of fossils. Humble scientists have found that spore and pollen research is a valuable supplement to fossil studies. It has, in fact, several distinct advantages over the study of both large fossils such as shellfish, and microscopic marine animals that fossil experts call forams.

For one thing, the world-wide distribution of spores and pollen makes them ideal as geologic signposts. Tossed with rare abandon by the four winds, they fall in almost every nook and cranny of the earth. Most pollen comes to rest near its source, of course, but some of it rides the wind for tens to hundreds of miles. Airplanes have even collected pollen grains over the middle of the Atlantic.

Well-preserved microfossils turn up in almost half of oil-well cuttings samples, whereas fossils visible to the naked eye normally occur in less than one per cent. In the upper part of Humble's Alaskan well, for example, geologists found few conventional fossils but ample spores and pollen to help them chart the rock layers the drill penetrated.

Especially does the minute size of spores and pollen make them helpful to oil hunters. Larger fossils fall prey to the grinding teeth of the drill bit, but the tough little spores and pollen slip through undamaged.

In addition, animal fossils may be dissolved from certain types of rock. Not so with spores and pollen. Coated with a chitinous armor (similar to the human fingernail) they are practically indestructible.

Although it was adopted by the oil industry only about a decade ago, spore and pollen study actually began much earlier. In 1833, after the invention of the compound microscope, an English botanist named Henry Witham observed fossil plant spores in a sample of coal. A hundred years later, the American coal industry applied spore and pollen studies to its exploration and production problems. Several oil companies started to investigate the potential of spores and pollen in the early 1940s.

What do oil scientists learn from these little messengers from the deep?

"About the same things we learn from other fossils," says Dr. Russell Jeffords, who set up Humble's laboratory in 1950, "but in greater detail. Lots of pages are still undeciphered in the book of geologic time, and plant microfossils fill in where other types of fossils are lacking. Spores and pollen help the oil scientist in three big ways: (1) they give us stratigraphic data such as the age, correlation, and zoning of formations; (2) they serve as environmental markers that add to the fund of knowledge to be evaluated in seeking oil; and (3) they give us records of the prehistoric forms of life."

Quick and accurate dating of sediments can mean the margin between success and failure in the highly competitive oil business, so spores and pollen are welcome additions to Humble's oil-finding tool kit. The Company's paleobotanists date sediments by studying the evolution of plant life through the ages. If a pollen that is abundant in a sediment of known age, for instance, turns up in an unknown sample, they know the two sediments accumulated about the same time.

First step in preparing spores and pollen for study is to isolate them from well cores and cuttings; technician decides on best method to decompose sample, release tiny grains.

Acid treatment is one stage of chemical and physical torture designed to purify sample; others include crushing, repeated baths in distilled water, centrifuging, and decanting.

Stained and mounted on glass slide, a single drop of residue contains countless spore and pollen fossils; no two of them look exactly alike, but many have similar characteristics.

In routine operations this knowledge can be of vital concern. One of Humble's production geologists may have trouble dating the rocks being drilled in a wildcat well. Electric logging fails to identify the horizon and apparently there are no fossils. Given a small sample of rock, the paleobotanists at Humble's Houston Research Center laboratory set to work releasing and concentrating the spores and pollen. Then by checking markings and shapes against enlarged photographs of other spores in the reference library, these scientists may be able to date correctly the sediment and to identify the formation.

In addition to age determination, spores and pollen perform many a service in solving correlation and zoning problems. Suppose, to take a hypothetical case, the same types of pollen are found at levels of 5,000 and 7,000 feet, respectively, in two wells several miles apart. Humble scientists can safely say the formations are the same geologic age; but what's more important, that the layers trend upward in the direction of the shallow hole. Such trends are highly valuable clues for oil-finding geologists. They point the way to anticlines, or local "highs" in the rock formations. Geologists maintain more than a good-natured affection for structural highs because there is where petroleum is commonly trapped.

SPORES and pollen also enable scientists to reconstruct environmental conditions of ages past. From studies off the Gulf and Atlantic coasts, paleobotanists get a pretty clear picture of nature's cycle long ago. Spores and pollen from plants along the swampy shore blew into the shallow water, the heavy grains falling close to shore, the lighter ones soaring farther out to sea. Out still farther, certain primitive one-celled animals made their home. Information on the relative abundance and type of microfossils in samples from several wells, therefore, helps the geologist visualize the old shoreline.

Humble's paleobotanists go about the job of dating some of the oldest things in the world without fanfare. The first traces of mankind go back a mere one million years, but with pollen, the scientists can date zones as far back as the Jurassic, laid down

about 150 million years ago during the heyday of the dinosaurs.

With the more primitive spores, they identify sediments back to the Devonian, deposited 350 million years ago when the simple seaweeds crept onto the land to evolve into lofty, cone-bearing trees. Older still are the hystrichs; they go back 500 million years to the dawn of the Cambrian age when the crusty, multi-legged trilobite reigned in primeval seas.

"Actually, our work is in two phases," says Dr. Stuart Levinson, present head of Humble's paleobotany group. "One is what we call control work; that is, setting up our reference library, filling gaps in the geologic timetable just as we were doing 35 years ago with the larger fossils. Right now, this foundation phase is taking up most of our time. Gradually, though, we'll be able to shift the work emphasis to where it begins to pay off, current field problems."

ONLY recently, a Humble oil scout came up with a field problem that Dr. Levinson and his team still remember. Thwarted in efforts to get information on a "tight" well, the scout visited the drilling site after the competing company gave it up for a dry hole. As a final, never-say-die gesture, he scooped up mud samples from the slush pit and sent them to Houston. Sure enough, Humble paleobotanists found tell-tale spores and pollen fossils. To his pleasure, the scout got almost as much information from the well as the company that drilled it.

Spore and pollen research is yet an infant in the oil industry, but data are piling up fast. One by one, a million and one unknowns are becoming knowns. Most oil scientists expect spore and pollen study to supplement, not replace, paleontology. But many predict micropaleobotany will surpass related fields in ultimate value to the petroleum geologist.

These remarkable little plant fossils, once washed unnoticed through the finest sample screens and down the drain, are today being put to work at expanding geological frontiers. In one sense, they typify the modern oil industry's ceaseless efforts to whittle down the odds against finding oil.

Spores and pollen, in other words, are blossoming into a geologic science not to be sneezed at.

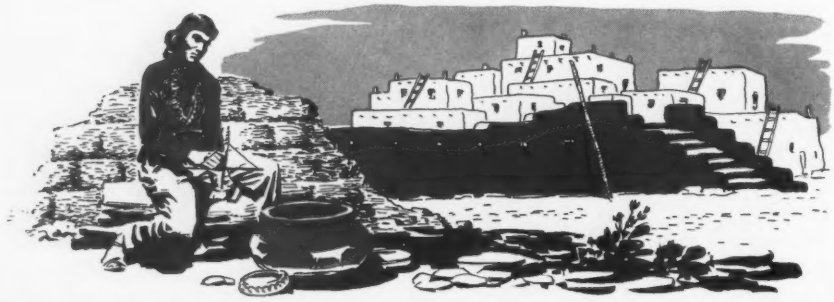
High-power microscope, fitted with 35-mm camera, helps Humble researcher to identify and classify spores and pollen. Magnified 1000 times, each is no larger than fifty-cent piece.

Reference library of slides, descriptive data, and photos helps solve field problems; Humble research team has catalogued spore and pollen samples from 10,000 wells all over world.

From rim of Canyon de Chelly, the ruins of ancient White House cliff dwelling can be seen in cave near the base of the wall at lower left.

Canyon de Chelly

Once a stronghold of ancient Indians, this scenic desert spot is now a National Monument



IN NORTHEASTERN Arizona, not far from the Four Corners area of current oil activity (see front cover), a rusty-red gorge cuts across the heart of the Navajo Country. This is Canyon de Chelly (pronounced de SHAY), once the home of ancient cliff dwellers, later a stronghold of the Navajo Indians in their desperate fight against the white man, and now a National Monument.

Miles from any paved road, and visited by relatively few of the thousands of vacationing tourists who pour into the scenic Southwest each year, Canyon de Chelly remains a lonely spot of rugged grandeur. From the white sands of its riverbed—dry most of the year—walls of solid red sandstone rise sheer and naked to heights of 800 feet. And nestled in natural

Looking up at White House ruins from canyon floor, visitor gets better idea of their size. Dwellings were built in cave first; later on ground.

caves along the face of these cliffs are hundreds of ruins of ancient dwellings, silent reminders of primitive peoples who lived and died here centuries before Charlemagne carved out his empire in Europe.

Among the 300 prehistoric sites and 138 major ruins found in the 83,000-acre Canyon de Chelly National Monument are many evidences of successive civilizations. Tree rings from structural timbers date some of the dwellings as far back as 348 A.D., when tribes now known as the Basketmakers built their crude log-and-mud shelters in the protected caves. Later, other more advanced tribes occupied the sites, building their dwellings on the debris of their predecessors.

The largest and best known of the existing ruins is the White House, a communal dwelling built by Pueblo Indians more than 800 years ago, at about the time the knights of Europe were launching their Second Crusade into the Holy Land. This cliffhouse, at one time four stories high, lies 50 feet above the canyon floor and once sheltered a village in which some 150 people lived.

About the year 1300, the Indians abandoned Canyon de Chelly for unknown reasons (anthropologists guess it was because of the great drouth of that period) and joined the Pueblo groups of Arizona and New Mexico. For three centuries the canyon remained virtually uninhabited. Then, in the late 1600s, the semi-nomadic Navajo drifted in and have remained ever since—except for one unwilling exodus.

That came during the War between the States, when Navajo raids on white settlements became intolerable. The Indians believed they had an impregnable fortress in the caves of Canyon de Chelly, but a force of Army troops under Kit Carson starved them out, rounded them up, and marched them on the "the long walk" to their first reservation near the Pecos River in eastern New Mexico.

A few years later, the Navajo were allowed to return to their ancestral homeland and many came again to Canyon de Chelly. Today, modern Navajo families live in their summer hogans in the canyon bottomlands. They grow peaches, cultivate small irrigated farms, and graze their sheep and goats on the canyon rims—just as primitive tribes have done for ages.

Clean Baytown Refinery skyline reflects efficiency of Humble's pollution prevention program. During the past 10 years, the volume of contaminants released to both the atmosphere and the Houston ship channel from the refinery has been reduced more than 90 per cent.

THEY PREVENT POLLUTION

Employees work 'round-the-clock to keep air and water clean at Baytown Refinery

Ecological surveys of ship channel help determine purity of refinery's effluent.

ONCE a week, on the Houston ship channel near Humble's Baytown Refinery, a young man can be seen seining from a 16-foot boat. Some of his actions, however, would amaze and confound a confirmed fisherman. When he hauls in a net load of flopping trout, mullet, or shrimp, he merely examines them, jots down something in a black notebook, then throws the catch back into the water.

Actually, this unconventional Isaac Walton is a Humble research chemist and "fishing" is part of his work in connection with the Company's anti-pollution program at Baytown Refinery. Observing the condition of various fish and marine animals at numerous points up and down the Houston Ship Channel helps him check on the purity of the effluent water flowing into the channel from the refinery.

This is but one phase of a large scale and long range pollution prevention program in which management and employees work together to maintain the refinery's position as an industrial good neighbor.

Their objective is to handle the vast amounts of sulfur, caustic, chlorine, tetraethyl lead, lime, acid, ammonia, clay, phenols, catalyst and other chemicals used daily in the refinery's treating operations in such a manner that there is little or no contribution to air or water contamination.

This isn't easy, for contamination possibilities are tremendous. Each day,

for example, more than 600,000 pounds of sulfur flow into Baytown Refinery in crude oil and another 200,000 pounds enter in the form of sulfuric acid for treating operations. In addition, the refinery each day gulps 50 to 60 tons of sodium hydroxide, nearly a ton of ammonia, and thousands of pounds of other chemicals needed to keep the units operating.

To control these potential contaminants Humble maintains a costly but highly effective program. The Company has spent more than $10 million in recent years on improved waste recovery processes and equipment designed to prevent air and stream contamination. More than a dozen trained specialists work on the anti-pollution project, and research scientists constantly seek new and better methods.

A major portion of the program centers around the 15 million gallons of fresh water that flow through the refinery daily. Essential as crude oil to the refinery's operations, this water—obtained from the San Jacinto River and from wells on refinery property—cools hot liquids and gases, makes steam for power, washes impurities out of petroleum products, and serves many other useful purposes. But in performing these jobs, it comes in contact with a wide variety of chemical treating agents and petroleum contaminants. Although some of the water is used over and over in the various processes, most of it must eventually be discharged into the Houston ship channel. One of the objectives of Humble's anti-pollution program is directed toward making this effluent stream equal in quality to the water in the channel.

THIS is particularly important because of the refinery's geographical location. Situated on the Houston ship channel approximately 20 miles from Houston, the refinery is the last major industry before the channel empties into Galveston Bay, and one of the few industries downstream from the point where the San Jacinto River enters the channel. Numerous shallow bays above the refinery add greatly to the recuperative powers of the water coming down the channel but there are no such helpful bays below the refinery. Therefore, it is desirable for Humble to discharge the highest quality effluent that is economically feasible.

Process water flowing through refinery moves to an open gravity separator pit where oil is automatically skimmed from the surface. Sludge is recovered from the bottom of the pit.

Since it is easier to keep impurities out of the refinery's water stream than to remove them after they enter, engineers concentrate their efforts on preventive rather than corrective measures. Obviously, one of the best ways to avoid contaminating water with chemicals is not to use them in the first place. That is one of the advantages of the hydrofining process now used extensively at Baytown. This catalytic hydrogenation process replaced sulfuric acid treating as a means of finishing motor gasoline, heating oil, and certain lube distillates.

The need for acid also has been eliminated in the manufacture of certain aromatics such as toluene. Today's clay treating technique does not require acid or other water-contaminating chemicals. Here again the use of a catalytic process has eliminated an acid treating operation and the air and water contamination problems associated with disposing of the acid sludge.

In those processes that do use chemicals, better recovery methods have been developed. Take sodium hydroxide for example. This caustic, used to remove impurities from oil, previously was segregated from the hydrocarbon streams by gravity settling. Much of it, however, was carried out of the treating vessel and found its way into the refinery's sewer system and hence into the water effluent. With new direct current electrical coalescers, the spent sodium hydroxide is almost completely recovered in the treating vessel and later is sold to outside companies. This innovation has cut sodium hydroxide contamination of

Effluent is cooled, reoxygenated by water from nearby bay before being discharged.

Sewage system and treating plant, large enough to serve city of 10,000 people, segregates sanitary wastes from industrial wastes.

Portable polarograph measures the dissolved oxygen content in channel. Another instrument determines the water's salinity.

the treated hydrocarbon streams by 98 per cent.

Other chemicals economically unsuitable for such recovery now are treated along with water in an Effluent Filtration Unit where objectionable materials are removed before the effluent is discharged into the ship channel. Five to eight per cent of total refinery wastes are filtered out in this plant.

With these and other preventive measures in operation, process water flowing through the refinery remains fairly pure. It is not clean enough, however, to turn untreated into the ship channel. Instead, it goes first to a covered separator pit where most of the petroleum liquids are recovered. The residue water then flows into an open gravity separator pit where any remaining oil is skimmed off the surface and sludge is recovered from the bottom.

THE clean effluent is then cooled and reoxygenated by mixing it with some 25 million gallons per day of oxygen-rich water pumped from nearby Black Duck Bay and finally is discharged into the ship channel near the refinery docks. This effluent approaches the quality of the water in the bays adjacent to the refinery.

As an added measure of prevention, the refinery also has put into operation a new and efficient sanitary sewage system and treating plant large enough to serve a city of 10,000 people.

An equally important phase of the anti-pollution program at Baytown Refinery concerns the prevention of air contamination. Humble, in fact, has spent approximately $4 million in recent years on improving the refinery's facilities to prevent atmospheric pollution.

One of the most important phases of this program concerns the reduction in the volume of sulfur dioxide gas discharged to the atmosphere. During the past few years, discharge of this gas has been reduced 60 per cent by means of new acid regeneration and sulfur recovery plants built by a chemical company adjacent to Baytown Refinery, specifically for processing Humble's spent acid streams. An additional 30 per cent reduction was achieved through improvements in refinery technology. For example, hydrofining processes convert sulfur compounds to hydrogen sulfide which is recovered by an amine scrubbing operation and sold to an outside company for the production of elemental sulfur.

Still another phase of Humble's air purification program bears a close relationship with the refinery's concerted efforts to reduce losses of valuable hydrocarbons. New storage tanks with floating roofs reduce vaporization; older tanks have long been equipped with vapor recovery devices.

The system for burning waste gases has been improved with smokeless flares. Fumes from asphalt oxidizing, caustic

Fish samples taken in survey are returned to lab for a microscopic examination.

concentration, and caustic regeneration operations are minimized by the use of fume burners.

As a result of the loss prevention and pollution prevention programs, Baytown Refinery employees can point to some highly encouraging statistics. The refinery's oil losses through evaporation, leakage, and spillage have been reduced to less than one per cent. That's one of the best records in the industry. In addition, the volume of contaminants released to both the atmosphere and the ship channel has been reduced by more than 90 per cent in the past 10 years.

THOSE are significant results, and refinery employees are determined to maintain their high standards. Members of the anti-pollution team make regular checks of the atmospheric conditions in and around the refinery to make certain there is no undetected air pollution; they also keep a running check on the refinery's effluent water. As an added precaution, water samples are periodically sent to the Texas A & M Research Foundation laboratory at Galveston to determine their effect on live fish.

But perhaps the most satisfying proof of the efficiency of the pollution prevention program is the small number of complaints received from the refinery's neighbors. During the past five years, there have been only half a dozen calls from complaining citizens. All were promptly investigated and acted upon.

Pollution prevention has an important place in the refinery's vigorous research and development program. New and better processes and equipment are constantly being studied and developed. Each new unit that goes on stream at the refinery must be designed to handle its own waste disposal and the necessary facilities must be engineered into the project. Considerable research also is being conducted on bacteriological treatment of chemical wastes.

But whatever has been and will be done by technology, Humble recognizes that the real heart of pollution prevention lies with employees themselves. As one refinery engineer recently commented, "pollution prevention around here is more than just an engineering problem, it's a state of mind."

This "people are more important than plumbing" attitude has led to effective organization of the pollution control program at the refinery. Committees composed of representatives from various refinery groups help plan and coordinate the work; the overall program is followed closely by engineers of the Technical and Research and Development divisions.

Take the Refinery Pollution Control Committee, for example. The 12 men on this committee make recommendations on operations of refinery equipment as it applies to pollution prevention. They recommend additional equipment when necessary and iron out problems that exist in plants already in operation.

An Effluent Committee composed of three members of Refinery Management handles long-range problems to see that every new unit has adequate facilities for pollution control.

Portable detection station continuously records volume of sulfur dioxide in the air.

An Oil Loss Coordinator and his assistant have overall responsibility for preventing losses of petroleum in the refinery. They check the effluent, look for leaks in chemical and oil lines, inspect any spills to see that they are cleaned up properly, and follow up on any reported loss conditions.

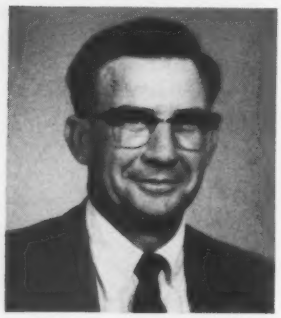
Interest in pollution prevention carries all the way from top refinery management personnel who make daily observations of the effluent streams down to the individuals who turn the valves and control the flow of oil through the various units. For example, two refinery employees received nearly $600 from the Coin-Your-Ideas Committee for suggesting an automatic control device on oil tanks that would prevent the loss of oil into the refinery sewer system.

Probably the only people outside the refinery who pay much attention to the pollution prevention program are the inspectors for various governmental agencies who check the results from time to time. These include representatives from the Harris County Health Unit, Texas Game and Fish Commission, Texas State Health Department, U. S. Coast Guard, and the Houston Port Commission. Otherwise the program, by its very nature, goes unnoticed.

And that, of course, is the best proof of its effectiveness.

In experimental oxidation pond hungry bacteria and algae purify water by consuming its organic matter. Each day these microscopic organisms cleanse about 1,500 gallons of effluent.

Galloway Elected to Board of Directors



James H. Galloway

James H. Galloway, assistant manager of the Production Department of Humble Oil & Refining Company since May 1954, was elected to the Board of Directors of the Company on December 17. In making the announcement, Morgan J. Davis, Humble president, called attention to Mr. Galloway's long service with the Company and his broad experience in producing operations.

Mr. Galloway, a graduate of Texas A & M, came to Humble in 1930 as a petroleum engineer. His field experience prior to World War II included service in East, South, and Southwest Texas where he became a district superintendent in 1941.

He entered the armed forces as a private in 1943 and rose to the rank of captain. After the war, Mr. Galloway returned to Humble as a district superintendent and in 1948 opened Humble's producing operations in California. He returned to Midland as assistant division superintendent in 1950 and came to Houston in 1954 as assistant manager of the Production Department.

Humble Honored for Football Broadcasts

C. E. Reistle, Jr.

A plaque commemorating Humble's 25 years of sponsoring Southwest Conference football broadcasts was presented to the Company on November 19 at a testimonial luncheon sponsored by Houston radio station KPRC and television station KPRC-TV. The plaque, which cited Humble's "faithful service to the football fans of the Southwest," was presented by Jack Harris, vice-president of The Houston Post Company in charge of the two stations, to C. E. Reistle, Jr., Humble's executive vice president. The first radio broadcast of a Southwest Conference football game was sponsored by Humble on station KPRC on October 27, 1934.

Gonzalez Reelected to Conference Board

Richard J. Gonzalez, director and treasurer of Humble Oil & Refining Company, recently was reelected a board member of the National Industrial Conference Board at its 388th meeting in New York.

The Conference Board, founded in 1916, is an independent and nonprofit institution for business and industrial fact finding through scientific research. It provides a source of facts and figures on all aspects of economic life and business operation.

The work of the Board is made possible through the support of more than 3,700 subscribing associates, including business organizations, trade associations, government bureaus, labor unions, libraries, individuals, and colleges and universities.

Seyfried Honored by API

W. D. Seyfried, at right, receives API citation from M. E. Spaght at annual meeting.

W. D. Seyfried, head of Humble's Refinery Research and Development Division, has been cited by the American Petroleum Institute "for distinguished service as a member (1948-56) and as an ex-officio member (1948-55) of the Executive Committee of the Advisory Committee on Fundamental Research on Composition and Properties of Petroleum; and as a member (1948-56) and as chairman (1948-55) of Research Project 48 Advisory Committee—Synthesis, Purification, and Identification of Sulfur Compounds in Petroleum."

The citation points out that "Mr. Seyfried's inspiring leadership and unquenchable enthusiasm in a vital segment of the research program have aided materially the efforts to understand the sulfur problem in petroleum for which the industry is deeply appreciative."

Suman Receives Coonley Medal

John R. Suman

John R. Suman, former vice president and director of Humble Oil & Refining Company and later a vice president and director of Standard Oil Company (New Jersey), was honored recently at the annual conference of the American Standards Association in New York City.

He was awarded the Howard Coonley Medal "for his leadership role in the advancement of the national economy through voluntary standards." Included among the former recipients is former President Herbert Hoover.

Mr. Suman has been a strong supporter and advocate of the advancement of voluntary standards since 1925 through his association with the American Petroleum Institute. He has served as either chairman or member of five API Committees which worked on the standardization of various oil field equipment. At the 35th annual meeting of the API in 1955, he was honored for his leadership in the API's standardization program.

Mooney Elected to Engineer Post

J. P. Mooney, staff engineer at Baytown Refinery, was recently elected a 1958-59 vice chairman of the petroleum division of the American Society of Mechanical Engineers. He has been a member of the society's executive committee for three years.

The 1958 conference held in Denver was attended by about 600 engineers representing domestic and foreign oil and gas companies.

Forty Years With Humble

Henry Curington, farm boss at Winters, completed forty years of service on October 5.

Recent Retirements

HUMBLE PIPE LINE COMPANY

Name	Location	Date of Retirement	Years of Service
John D. Clark	Longview District	September 1	30
Roy B. Fridge	Refugio Station	August 1	30
Chester P. Hardwick	Groesbeck	August 1	32
Wylie H. Harper, Sr.	Mexia District	December 1	31
Burton H. Jones	Cisco	August 1	38
Joe M. Larkin	Odessa Office	November 10	35
Hans O. Larson	Longview Station	December 1	31
Dewey R. McCoun	Refugio	August 1	37
Gilman W. Mitchell	Southern Division	August 1	31
Robert P. Moore	Childress	October 14	33
Oscar M. Olds	Gilmer Station	August 1	35
Robert A. Pate	Longview Connection	August 1	31
Willie D. Rougeou	Luling	August 1	28
Charles W. Salmon	Satsuma Station	September 27	31
Frank M. Stubbs	Anahuac	November 20	29
George W. Upshaw	Hawkins	August 1	34
Beverly Evans Warnell	Talco	August 1	29

HOUSTON OFFICE

Roy E. Armstrong	Office Buildings	October 26	35
William W. Armstrong	Marketing Accounting	November 22	33
Sam H. Barton	Marketing Accounting	November 10	38
Gustaf M. Borgstrom, Sr.	General Sales Div. Marketing Department	October 3	40
John T. Bowers	Office Buildings	November 2	37
Donald A. Dibble	Production & Exploration Accounting	November 29	35
Francis T. Fendley	Purchasing Department	October 17	39
Harry N. Grantham	Production Accounting	December 7	33
William E. Hubbard	Production Proration	November 9	38
Alvin A. Klein	Production Operating	October 13	39
John W. E. Schneider	Purchasing Department	October 5	37
Lancaster T. Rudolph	Marketing Accounting	November 10	29
Robert F. Weyerman	Houston Package Terminal	October 29	21

BAYTOWN REFINERY

Name	Location	Date of Retirement	Years of Service
Melchior G. Balderas	Labor Department	September 7	22
Walter M. Brooks	Railroad Department	September 15	18
Arthur Bryan	Electrical Department	October 1	29
Robert R. Cates	Butadiene Plant	December 17	36
William T. Clepper	Boilermaker Department	August 1	30
George H. Ferguson, Sr.	Machinist Department	November 9	30
Bertrand W. Fritch	Research & Development	November 11	15
George G. Grosjean	Benzene Unit	September 1	22
Charlie Harrell	Pipe Department	November 1	15
William N. O'Rourke	Community Houses	November 19	25
Kian F. Rountree	Railroad Department	September 1	21
Wesley E. Scarbro	Butadiene Pumping & Gauging	October 1	30

PRODUCTION DEPARTMENT

Raymond C. Allen	Avery Island	September 11	27
Frank L. Ballard	McCamey	November 23	31
Robert B. Brown	Western Division	November 8	39
Carey P. Bryant	Hawkins	August 1	29
Remus Burgin	East Texas Division	November 13	34
Kinzy R. Dawson	Pampa	October 23	38
Walter M. Eddins	Stratton	October 13	29
Jim Farrow	Flour Bluff	August 1	33
Willie M. Ferguson	Western Division Office	November 24	25
Henry W. Kueteman	Friendswood	August 1	28
Clifton G. Lincecum	Flour Bluff	August 1	31
William A. Mathis	London	August 1	32
Henry D. Morrow	Hawkins	August 1	33
Walter W. Phillips	Gladewater	December 16	36
Eugene F. Schweizerhof	Gulf Coast Division	November 1	32
Cloma L. Sims	Avoca	October 31	35
William A. Spivey	Gladewater	October 26	35
Otto G. Sternenberg	Greta	August 1	29
William J. B. Vernon	London	August 1	35
Uel T. Whisenhant	Ganado District	September 1	22
Thomas W. Williams	Friendswood	August 1	25

Deaths

Employees: Daniel B. Allen, 38, senior gas engineer in Gas Engineering in the Houston Office, on November 12; Leopold W. Baker, 55, clerk at Baytown Refinery, on October 17; Sylvian Hebert, 32, lease pumper-gauger at Grand Isle, on November 5; Clyde W. Harrison, 51, lease pumper-gauger at Liberty, on October 14.

Isaac D. Huggins, 44, maintenance mechanic at Baytown Products Terminal, on October 7; Ernest Hudson, Jr., 54, district manager Marketing Northeast Texas Division, on October 29; Richard K. Johnson, 44, machinist at Baytown Refinery, on November 3; Robert E. Lee, 37, rigger first at Baytown Refinery, on September 21; Ottis C. Lloyd, 57, lease pumper-gauger at London District, on November 9.

Annuitants: Roy E. Filler, 50, former assistant district gauger for Humble Pipe Line Company at Anahuac, on October 24; Florian Gerbig, 66, former terminal foreman at Harbor Island, on September 12; Lester C. Grisham, 60, former rotary driller at Pampa District, on August 31; William R. Lauderdale, 66, former pipeliner at Tomball Connection, on August 28.

Henry L. Laughlin, 70, former watchman at Talco District, on October 15; Milton L. Laughlin, 65, former watchman at the Houston Bulk Station, on November 2; John D. Lewis, 58, former pumper at Baytown Refinery, on September 30; Thomas J. Mace, 74, former lease pumper-gauger in the London District, on October 30; John W. Manning, 80, former pipeliner at Webster Station, on October 8.

Clyde D. Nelms, 62, former gang pusher first at Baytown Refinery, on September 20; Ottis A. Parker, 65, former shift supervisor at Baytown Refinery, on November 10; Farliss W. Pope, 71, former separator pumper at Baytown Refinery, on November 8; Gilbert C. Rosenthal, 74, former division engineer at Humble Pipe Line Cisco Operating Field, on October 29; Olmir R. Skaggs, 72, former carpenter supervisor at Baytown Refinery, on October 31.

By the way

● Gil Chambers, chemist who works with Humble's pollution prevention team at Baytown refinery (see Pages 18-21), claims he has netted some 75 different species of fishes while conducting ecological surveys in the ship channel and the bays adjacent to the refinery. The granddaddy of all these catches, he says, is the big alligator

gar, pictured here, which he captured with a hand net. Although nearly four feet long, the gar offered little fight and allowed itself to be hauled in for portrait taking.

Shortly after the picture was taken, Chambers, right, and Jeff Viereck, technician in the research and development division, returned the fish to the ship channel. The big fellow swam away quietly.

● If Humble's San Gabriel Freeway wildcat (Page 7) turns out to be a dry hole nobody can say we weren't forewarned. Earl Hilton, the Company civil engineer in charge of preparing the drilling site, reports that a visitor has already predicted the test would be a failure.

The man appeared at the location one day carrying a forked stick with a small bottle of oil tied between the branches. Silently and carefully he walked over the site, holding the witching stick before him in the approved technique. Then he approached Mr. Hilton. "You're wasting your money drilling here," he announced with firm conviction. Pointing off in the distance, he added, "The oil is over there."

● Because many Texans are fond of California-bred tomatoes, Humble recently found it wise to re-route an access road in Southern California.

The Company needed to build the road to serve a wildcat well location. It could go through a tomato field or a bean field. The tomato field offered the most direct route, but the owner of the tomato plants valued his crop at $750.00 an acre. Reason: all plants were hand-pollinated. The crop was being grown for seed, and the entire output was to be sent to seed buyers in Texas.

Humble routed the road through the bean patch; the beans were valued at only $250.00 an acre.

● For the tourist who likes a vacation spot off the beaten path, Canyon de Chelly (see Page 16) is just the place. The best approach is from U. S. 66, by way of Gallup, N. M., to Ganado, Ariz., to Chinle, the gateway to the National Monument.

The name "de Chelly," incidentally, probably is a corruption of the Navajo *Tse gi,* which means approximately "rock canyon."

Baytown refinery processed its two billionth barrel of crude oil on December 9.

It took the big plant some 27 years to process into a variety of petroleum products the first 1,000,000,000 barrels. That was between May 1920, when the first crude oil was charged to stills, and May 1947. The second billion barrels was processed in the last 11½ years, indicating the rapid expansion which has taken place at the refinery.

Two billion barrels is a lot of oil. In fact, even at today's high consumption in this country, the total output of the refinery would be enough to supply all of the petroleum needs of the whole nation for 200 days.

The Humble Way

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Core test drilling off West Coast is a joint venture of Humble and Standard Oil Company of California.